



Aalborg Universitet

**AALBORG UNIVERSITY**  
DENMARK

## Cadastral Research - Issues and approaches

Stubkjær, Erik

*Published in:*  
Kart og Plan

*Publication date:*  
1999

[Link to publication from Aalborg University](#)

*Citation for published version (APA):*

Stubkjær, E. (1999). Cadastral Research - Issues and approaches. *Kart og Plan*, årg. 92(Bd. 59, nr. 3), 267-278.

### General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal -

### Take down policy

If you believe that this document breaches copyright please contact us at [vbn@aub.aau.dk](mailto:vbn@aub.aau.dk) providing details, and we will remove access to the work immediately and investigate your claim.

# Cadastral Research – Issues and Approaches

Erik Stubkjær

*Erik Stubkjær: Cadastral Research – Issues and Approaches*

KART OG PLAN, Vol 59, pp. 267–278, P.O.B. 5029, N-1432 Ås, ISSN 0047-3278

In Denmark land management includes cadastral issues, property law, and certain economic issues. The article restricts itself to the cadastral issues and presents a survey of the cadastral problem domain. The survey is based on an early Danish cadastral work, and on two internationally oriented textbooks.

The textbooks present cadastre in the context of information systems. Consequently, a selective survey of information systems research is made, focusing on natural science (positivist) and alternative paradigms. It appeared that the alternative paradigms became recognised in information systems research around 1990 and some years later in GIS research. The development suggests viewing the cadastre in its cultural context. It is discussed whether this can be done within natural science faculties.

Danish experiences with information systems development have earlier been reported with reference to network theory (Stubkjær, 1992). A similar approach was identified within recent ISD research. This and the above survey led to proposals for the design of future cadastral research.

**Keywords:** Cadastre. Kataster. Problem domain. Information system. Information systems development. Research design. Paradigm.

*Erik Stubkjær*, Professor, Lic. Agro. (PhD), Department of Development and Planning, Aalborg University, Fibigerstræde 11, DK-9220 Aalborg Øst, Denmark.  
E-Mail: <est@i4.auc.dk.> UML: www.i4.auc.dk/est/

## 1. Introduction

In some countries cadastral issues have been taught at institutions of higher education for more than 100 years. This is due to the need of the society for high-level qualifications regarding transactions concerning land and real estate, including the change of boundaries of real property.

Transactions concerning real property, and hence the cadastral subject area, are described in terms of legal prescripts. It would, however, be misleading to conceive the field as a sub-discipline within law. This is because the cadastral subject area includes substantial technical elements. For example, the legal determination of the boundary of real property is based on identification and measurement of objects in the field. Also, the maintenance of national or regional databases on real property and related rights and obligations demands substantial technical knowledge, especially because of the geospatial nature of the recorded data. The technical knowledge is provided by profes-

sionals and represented in an international setting by FIG, the International Federation of Surveyors.

During the 1970s and 80s the cadastral issues got an international dimension. This was partly motivated by a concern, hosted by the UN and other agencies, to support developing countries with incomplete or non-existent cadastral systems. Another impetus for an international perspective on cadastral issues was the fact that the diffusion of applications of computer software was hampered by national peculiarities. The development of general models of the diverse, national cadastral systems might reduce these barriers. Finally, research efforts, also within neighbouring and emerging disciplines like cartography, geographical information systems, and computer science by the very nature of research introduced an international dimension into the cadastral subject area.

The Danish term of the cadastral field is 'matrikelvæsen'. The term derives from late Latin *matricula* – register, as in the matriculation of students of a university, that is to enter

information into a form (*matrix*). The suffix: '-væsen' probably emerged within *Kameralwissenschaft* (Zincke, 1755) and denotes the institutional aspects of a field. The term '-væsen' is approximated by English terms like service, authority, or system.

Cadastral and related teaching has expanded its part of the Danish study programme for chartered surveyors from about 1/6 around 1970 to 2/7 now, largely at the expense of the disciplines of drawing and site development and drainage ('Jord og Vand'), which were phased out. Surveying, mapping, photogrammetry and remote sensing, and GIS cover about 4/7, and spatial and public planning dominates the remaining subjects. The umbrella name of cadastral teaching is 'Arealforvaltning' – Land Management. The majority of cadastral study elements are lectured during the 3rd study year and includes cadastral law and procedures, property law with land registration, assessment for property tax and compulsory purchase, and property registration at large, with legal aspects of GIS.

In the following I shall outline my view of cadastral studies, by focusing on cadastral research. I write primarily for staff at university departments, who relate themselves to FIG, and for researchers in related disciplines. My special concern is the colleagues in European countries in transition, where geodetic studies have a recognized position among the natural science disciplines. It is a challenge to maintain that position when social science elements must be appropriated more weight within the study programmes.

The limitations of the paper mean that substantial issues are left out:

- Economy with transaction cost theory, regulatory policy, and economics of information
- Sociology of professions, of organisations, and of science
- Law in terms of sociology of law, and the important study of positive law
- Political science, especially from the point of view of governance and implementation
- Geography, with urban dynamics, spatial analysis, and GIS, and
- Linguistics and knowledge engineering, providing an approach to elicit general knowledge that is carried by legal and other texts, and to use it for improvement of education (cf. Stubkjær, 1994)

The following pages aim at charting the cadastral problem domain and developing grounded suggestions for the design of further cadastral studies. To gain perspective, section 2 refers to early Danish cadastral research and indicates essential components of the domain. Section 3 extends the scope to the worldwide by means of two textbooks in the cadastral field (Dale & McLaughlin, 1987; Larsson, 1991). Common for the three works is that they aim at covering a totality, rather than focusing on a specific issue. The two textbooks introduce the importance of information technology for cadastre and land management. A substantial amount of cadastral issues may thus be conceived as a subfield within information systems research. If this position holds it means that the approaches and methods of information systems research can be applied for cadastral studies. Section 4 provides for a selective survey of information systems development (ISD) research.

The main reason that cadastral research is not entirely a subfield of information systems research is that ISD research is mainly concerned with information systems in the industry, while the specific conditions which regard governmental information systems are less explored. Cadastral systems may be organized as a purely governmental affair, or – alternatively – rely on market-based services. Decisive is that the cadastre is rooted in the government and may be conceived as an instrument of law and order. Therefore cadastral research must take into account the power relations and specific cultures of the government. Section 5 refers to ISD research that addresses these issues.

It is contended that a cadastre presupposes a specific culture, a bureaucratic maturity, to operate. While GIS technology expands worldwide, the cultural implications may question the role of cadastral research outside the European homeland of the cadastre. Section 6 develops on the cultural aspects and outlines alternative approaches to cadastral research. A conclusion closes the paper.

## 2. Cadastral studies – An emerging discipline

In Denmark the first cadastral position within higher education was established in 1874 (Betænkning, 1972), and the first professor was installed in 1970. It branched from the discipline of surveying (in Continental Europe one

would say: the discipline of geodesy). The first holder of the cadastral position, the reader E. Mørup, rather quickly provided a compendium of circular letters and decisions on cadastral issues (Mørup, 1880, 1893). The scientific contribution is not the compendium as such, but the naming and ordering of the elements of the cadastral subject matter.

It is a classical activity in science to open a new subject area by describing and naming the elements of the subject area. Prominent examples include the botanical system of Linné (*Systema naturæ*, 1735), and the table of elements by Mendeleejev, and Lothar Meyer, respectively (about 1869).

Mørup was concerned with governmental practice and teaching, rather than with the nature. His elements were ministerial letters. Mørup named 35 classes to which he allocated relevant prescripts from 1782 to his own time. So far, we do not know of his ordering principles. Catchwords of the classes were organized alphabetically, and within the classes the letters were put in chronological order. In Figure 1 below the 35 classes are structured into 6 groups, to make the cadastral universe of Mørup more explicit. His own numbering and wording appear (in Danish) in the right column. Some Danish cadastral terms are not translated.

From Figure 1 it appears that legal rules regarding terrain objects of different kinds motivated the largest number of classes. The second largest group includes the different types of cadastral procedures, which got one class each. The group includes procedural rules for expropriation where chartered surveyors had (and have) a statutory task.

Compared to other countries it is worthy of note that no prescripts were issued which demanded a certain quality of measurements and calculations. This is due to the fact that theory-based quality measures were developed in Germany during and after Mørup's time. Also, prescripts on permanent boundary marks and other monuments did not get special mentioning until the present century.

From a recent systems analysis perspective you miss a reference to what is today called databases. The ledgers and archives of Mørup's time were largely internal ministerial business; only copies and certificates were relevant to the outside, cf. the group: Prescripts on documents. Also, reference to land law: the conceptions of real property, title, mortgages, easements, etc. is

missing or appears only implicitly from Mørup's classification.

The classification by (Mørup, 1880) is, nevertheless, worth mentioning. His efforts were useful for the profession, by providing an easy access to the knowledge that was needed by the surveyors, and his classes are still indicative of essential cadastral elements, even if they are not all embracing.

### 3. Cadastre and information systems

Mørup's classification characterizes a cadastral subject area with the following elements: An *organizational, partly governmental structure* provides the setting for *procedures* that convey information in the form of *documents on terrain objects, which are statutorily described*.

The following extends the discussion of the cadastral subject area by means of two textbooks: Land Information Management – An introduction with special reference to cadastral problems in Third World countries (Dale & McLaughlin, 1989), and Land registration and cadastral systems – Tools for land information and management (Larsson, 1991). Both textbooks use the term *Land Information* as a general term, in accord with the title *Land Information Systems* that was adopted in 1978 by the International Federation of Surveyors (FIG) for one of their scientific commissions (Eichhorn, 1981).

(Dale & McLaughlin, 1989) present a taxonomy of information systems where Land Information Systems is the term applied for systems related to large map scales (generally used for cadastral purposes), while Geographical Information Systems (GIS) is the term applied for small map scale systems (mostly used by geographers). The latter term became, however, the general term for the rapidly developing research field, cf. (Longley et al, 1999).

The two textbooks discuss cadastral and related issues in the context of management of information systems. They present the new subjects: Information management and related economic issues, together with more traditional material: Surveying and mapping, and law. Figure 2 overleaf provides a survey of the chapters of the two textbooks according to the mentioned disciplines.

The scope of the survey justifies that a chapter is generally related to only one content headline. Larsen's chapter 11 addresses legal as well

Terrain objects to which specific rules apply	2) Washed away areas (Bortskyllede arealer) 5) Joint property units (Fælleslodder) 7) – (Gadejord) 9) Fences (Hegn) 10) Railroads (Jernbaner) 11) Midwife's house (Jordemoderboliger) 12) Churchyards (Kirkegårde) 21) Mills (Møller) 25) Sand drift areas (Sandflugtsstrækninger) 27) School plots (Skolelodder) 28) Forests (Skove)
Procedure rules for cadastral and related cases	4) Expropriation (Expropriation) 19) Exchange of land (Magelæg) 23) – (Omdeling af fæstegods) 24) Amalgamation (Sammenlægning) 30) Registration of title (Thinglæsning af adkomstdocumenter) 32) Partition of co-owned property unit (Udskiftning) 33) Subdivision (Udstykning)
Legislation to comply in cadastral cases	3) Building and fire protection (Bygnings- og brandvæsen) 6) Tenants and ordinary estates (Fæstevæsen og Bondejords behandling) 18) Entailed estates (Lehn og Stamhuse) 22) Sanitary prescripts Næringsvæsen 34) Watercourse services (Vandløbsvæsen) 35) Road services (Veivæsen)
Taxes and duties, incl. soil fertility classification	13) – (Kongelige Penge .. og andre afgifter) 16) – (Landskatshartkorn) 26) System of taxation (Skattevæsen) 29) System of stamp duty (Stempelvæsen) 31) Transfer duty to private persons (Tiende)
Organisation of the cadastre and related administration	15) Chartered surveyors (Landinspektører og Landmaalere) 17) Quasi judicial commissions (Landvæsenskommissioner) 20) Cadastral service (Matriculsvæsen)
Prescripts on documents	1) – (Attester om hartkorn) 8) Copies and certificates (Genparter og udskrifter) 14) Maps (Kort)

Figure 1: 35 classes used by (Mørup, 1880) in a compendium of cadastral prescripts

as information management issues, and is thus recorded twice. It appears that the authors largely agree on the subjects covered.

Both textbooks introduce issues, which were not mentioned in the context of Mørup's classification, but which are inherently cadastral. The international perspective of the textbooks makes it evident that land parcels can be identified in several ways. As a consequence, alterna-

tive parcel reference systems (Dale & McLaughlin, 1989: 39f) and land unit identifiers (Larsen, 1996: 157f) are mentioned. An early record of the land parcel identifier issue is (Moyer & Fisher, 1973).

The identification of parcels and real property units has to be completed with information on the relative location and form of the lots. For most countries in Europe the analogue, cadastral maps serve that purpose, supplemented by

<i>Textbook content</i>	<i>Dale &amp; McLaughlin</i>	<i>Larsson</i>
Introduction, history, visions, conclusions	1. Land information 3. The fiscal cadastre 4. The multipurpose cadastre 12. Conclusions and recommendations	1. Land information systems 2. Cadastre and land registration 3. Historical development .. 4. .. systems in Europe 5. .. in English-speaking countries
Surveying and mapping	5. ... spatial referencing 6. Surveys and mapping	9. Cadastral surveying
Legal issues	2. Land registration	10. Adjudication (of rights in land) 11. Registration (of rights in land)
Management of (geo-)information	7. Digital mapping 8. Data management 11. Management issues	11. Registration (, organization of) 13. Organization, automation, education
Economic and feasibility issues	9. The economics of LIS 10. Institutional arrangements	6. Benefits of cadastre and land register .. 7. Further benefits .. Calculating benefits 8. Feasibility studies 14. .. ways of simplification

Figure 2: Survey of issues covered by two cadastral textbooks

monumented, geodetic control networks, cf. (Dale & McLaughlin, 1989), chapters 5 and 6. Both textbooks address the issue of quality measures, mostly from the perspective that the benefits of cadastre/land registration systems can be achieved with lower demands on measurement standards (Larsson, 1996: 96; Dale & McLaughlin, 1989: 27f, 126).

The geodetic information is metric, but important spatial information, e.g. neighbour relations, is of an ordinal rather than a metric nature. (Dale & McLaughlin, 1989) mention spatial referencing that is not related to the centre of the earth, e.g. 'metes and bounds'. Also, you can describe routes and the location of premises without referring to co-ordinate systems. (Stubkjær, 1992) mentions several, metric and non-metric, spatial reference frames.

Regarding the legal issues both textbooks discern between title and deed registration of real property and mention the main sections of the land registry: property (identification) section, the proprietorship section, and the encumbrances section, including mortgages and easements. It appears that the authors take an information system, rather than a legal view of the issue. The information systems aspects are more fully addressed below in section 4.

Both textbooks introduce economic and feasibility issues. It must be noted, however, that the issue is introduced in a way that does not match Danish experiences, e.g. regarding the development of the national information system (frequently called 'register') on Buildings and Premises (1974-80), cf. (Stubkjær, 1992). As a matter of fact merging interests of the participating parties motivated the Danish development. A cost/benefit estimate of the project was made, but not much discussed.

This is in contrast to the development approach taken by the two textbooks, which emphasizes a rational analysis of problems, assessment of benefits and costs, decision on Land Information project, implementation, and monitoring. The established Land Information System will in turn improve decision-making, cf. Figure 3 below.

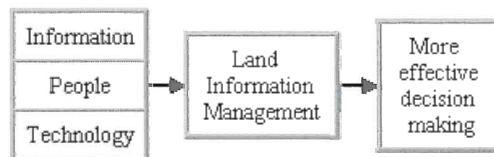


Figure 3: The land information management challenge (Dale & McLaughlin, 1989) Fig. 1.8

illustrated by a paper by G. Feder for a World Bank seminar in 1986, a paper that is quoted by both textbooks. The reasoning goes that titled land provides security to farmers as well as to lenders, which will trigger more investment. The increased investment provides for more variable input use, which in turn gives higher output, higher income, and higher prices in land (Dale & McLaughlin, 1989: 174f; Larsson, 1996: 58f).

Rationalistic reasoning has motivated the development of information systems, too, but the reference to Danish experiences above indicate, that such logic of development not always correspond to reality.

Research in the field of information systems development provides for alternative conceptions, which fit better with experiences, as will be described in section 4.

Summarising, the survey of the contents of the two textbooks demonstrated that cadastral issues are related to several disciplines: Surveying and mapping, law, information systems, and economics. The dominant role of the information systems discipline appears from the introduction and scope of the land information textbooks and from the way legal issues are treated, rather than from the amount of chapters, which specifically addresses information systems.

Furthermore, the survey suggested an extension of the list of cadastral issues, which originated from Mørup's work, including *parcel identifier* and *spatial reference frames*, which identify and locate information on terrain objects in *databases*.

Finally, it was noted that the development logic of information systems, as described by the textbooks, differed from Danish experiences.

A tentative view of the cadastral problem domain (a 'root definition', cf. Checkland, 1981, as summarised by Hirschheim et al, 1995) is presented without comments as figure 4.

#### 4. Research in information systems development

The previous section established *information systems* (IS) as a context for cadastral studies. The economic potential and various consequences of computer technology have attracted substantially more intellectual resources to this new field, and to the field of GIS, than to cadastral studies. Therefore, it is beneficial to draw on experiences from the IS and GIS research. The research regarding computers and information systems is overwhelming, and the research focus has developed over time. The present survey focuses on the basics of research: methodo-

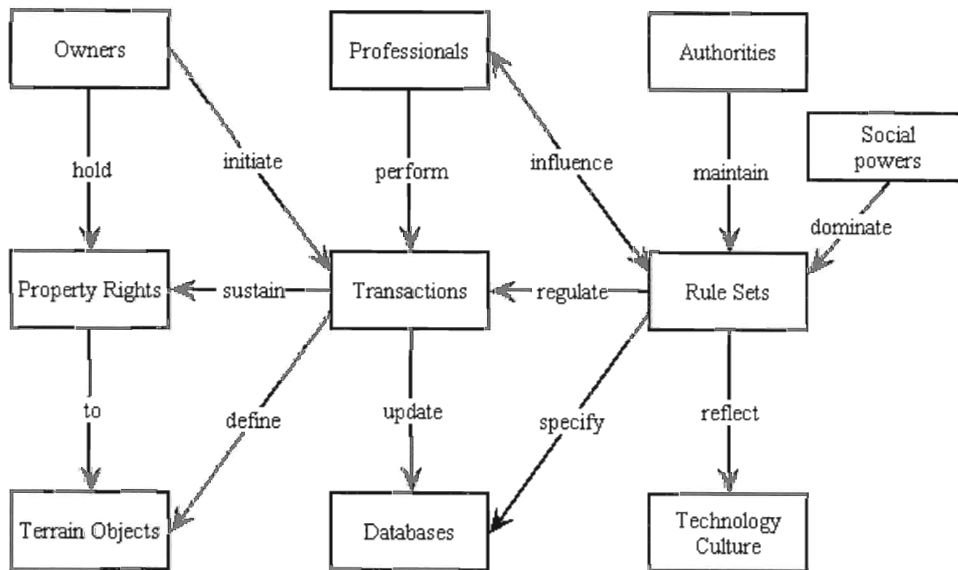


Figure 4: A view of the cadastral problem domain

logy and reality conception and include the purpose of finding an answer to the discrepancy mentioned above between a development logic based on economics and the Danish experiences.

It appears that early *computer science research* was techno-centric and largely restricted to the traditional engineering disciplines. The development of information systems benefited from computer technology, as it became available during the decades: Computer aided systems engineering (CASE) tools were developed by applying the available technology for systems analysis and design. Prototyping became part of the development strategy as standard software packages and graphical user interfaces became available, and object-oriented analysis and design methods have been developed as a reflection of object-oriented software engineering. Improvements of information systems development methods are, however, not only due to the technological impact.

Research into the human and organizational aspects of information contributed to the development, as did new technology. From an organizational perspective one can note that early systems development methods assumed a rational and hierarchically structured organization, which called for a similarly structured development process. The concern for achieving well defined goals in an optimal way originated in the hierarchically structured, armed services. The developed methods were applied by private enterprises, and from the 1960s used by governmental agencies to provide products and services effectively.

Human and wider organizational aspects were included in the IS research during the 1980s (e.g. Bjørn-Andersen et al, 1986; Eason, 1988). In Scandinavia the research had specific reference to trade unions. From the 1990s social and philosophical issues were addressed as well (Floyd et al, 1992; Dahlbom & Matthiassen, 1993; Hirschheim et al, 1995). This development marked an important distinction between research in computer science, and research in information systems. Computer science research, as represented by (Denning, 1989), shares the basic assumptions of reality and scientific enquiry with (natural) science, while research in information systems includes, and often largely relies on, the research paradigms of sociology.

(Klein, 1999) refers to a paradigm shift in *MIS Quarterly* and three articles in *Communications*

*of the ACM* during 1989 as a turning point in the IS research. One of the articles (Denning, 1989) described a 'Core of Computer Science' that may be related to a positivist viewpoint, while the two other articles stated and developed upon alternative approaches to information systems development and information systems research. Klein notes that a debate of paradigms hardly took place. Within few years it became accepted in research circles to consider «three research paradigms in information systems research, namely the positivist, the interpretivist, and the critical» (Klein, 1999: 20). Positivism is, however, still the most frequent type of research, as counted by the number of articles and other research contributions.

The research within *geographical information science* (GIS, replacing the former notion of geographical information systems) has similarities with the research in computer science and information systems. In both cases the discussion on paradigm and worldview became manifest in research, however, with some delay in the specialized field. J. Pickles refers to a workshop at Friday Harbor, November 1993, which raised «Questions of origins, epistemology, ..., forms of representation, and the politics and ethics of information (which so far) have generally been seen as marginal to the more technical questions of systems development and application ...» (Pickles, 1999: 54).

The discussion of research paradigms furthermore becomes visible through special issues of journals. In the field of information systems mention is made of 'Social Science Perspectives on IS' in *ACM Transactions on Information Systems* (Kling, 1994), and the more comprehensive special issue: Research on Systems Development – Position and critique, in *Accounting, Management and Information Technologies* (Hirschheim, Klein & Lyytinen, 1996). The GIS complement is the special issue: GIS and Society in *Cartography and GIS* (Sheppard, 1995).

Finally, the different worldviews may be related to departments. It has been observed that information systems research is performed to a great extent at business departments (Kling, 1999). Therefore, one can imagine a division of work between computer science departments, working within a natural science paradigm, and business department research in information systems within social science paradigms.

Also in geography a division is made between researchers and departments with different



	Computer science/ Information systems	Geographical Information
Worldview discussion surfaced	Three articles in <i>Communications of the ACM</i> , during 1989.	National Centre for Geographical Information and Analysis (NCGIA)'s Friday Harbor Workshop, 1993 Pickles: Ground truth, 1995
Special issues of journals	Social Science Perspectives on IS <i>ACM Transactions on Information Systems</i> (1994) 12/ 2  Research on Systems Development – Position and critique <i>Accounting, Management and Information Technologies</i> (1996) 6/ 1-2	GIS and Society <i>Cartography and GIS</i> (1995) 22/ 1
Labels of 'schools' or approaches	computer science; (natural) science, positivist	'spatial analysts'; technicist, instrumentalist, positivist
	information systems; interpretivist, critical	'social theorists'; hermeneutic, critical

Figure 5: References to literature on 'worldview' discussions in computer science and in geographical information science.

worldviews. In geography physical geographers, that is staff of departments of physical geography, are counted as 'spatial analysts' that take a natural science approach. Human geographers are divided: some are 'spatial analysts', too, some are called 'social theorists' (Johnston, 1999: 42, referring to Sheppard, 1995). (Johnston, 1999) presents a typology of 'the nature of science': empirical, hermeneutic, and critical, which provide partly alternative conceptions of the reality (ontology) and how it can be inquired (epistemology).

It is worthy of note that the paradigms of sociology are apparent not only in philosophical treatises, but also in empirical research, e.g. (Gärtner & Wagner, 1996). Their article describes actors, arenas, networks, and procedures, respectively, in a case study of information systems development in Germany and Austria. These are the concepts which (Stubkjær, 1992) used to describe the development of Danish national information systems of the 1970s.

The above selective review of research in information systems and in geographical information systems, thus did succeed in finding a research approach that fits the mentioned account of Danish experiences. Furthermore, the review provides a reference for an interpretation of the two cadastral textbooks, which

were discussed in the previous section: They appear to be written in the same tradition as the first phases of computer science research. Organizational and other social science issues are addressed by the textbooks, but as context rather than as an issue for investigation, and the development logic that is presented in the textbooks is as rational as the computer science paradigm.

The review of the present section touched upon methods and techniques, which are relevant for cadastral studies, e.g. CASE tools, but focused on research on the reality relation of information systems. It was established that the natural scientist, positivist paradigm was questioned during the 1980s and 90s and in some research departments supplemented with alternative paradigms.

Cadastral research must include alternatives to the positivist paradigm. However, as cadastral studies in Europe are generally related to natural science disciplines (surveying and geodesy) and located within a faculty of science, it is considered a drawback if cadastral research should be based on a paradigm that does not relate to the positivist paradigm. The challenge is thus to draft a research approach that accepts different

worldviews in a consistent way, for example similar to Heisenberg's uncertainty principle (Heisenberg, 1927). The challenge is addressed in the following section, by developing on the article by Gärtner and Wagner and relating it to a previous attempt of establishing a theoretical basis for cadastral studies (Stubkjær, 1996).

## 5. A theoretical basis for cadastral studies

(Gärtner & Wagner, 1996) present a theoretical framework for the development of information systems in a political context. The framework enables a discussion of the political and organizational context of the design of information systems, including the participation of the parties concerned. This is highly relevant for cadastral research, as

- cadastral information systems are part of the public administration,
- their development has frequently political implications, and
- more parties are mostly involved.

Three *social arenas* for participation are distinguished: designing work and systems, designing organizational frameworks for action, and designing the industrial relations context, respectively. A social arena is «a place in which different communities of actors meet to discuss shared or overlapping projects and concerns» (:191-2). «Each arena of action has its own set of legitimate agendas – from questions of user interface design to quality of working life and privacy issues» (:188). Arenas need not be limited by boundaries, agendas, and values set by existing organizations and their subunits; they may rather extend across such limitations, and change over time.

*Actors* interact in *actor networks* as representatives of, for example a professional community, an organizational unit, a setting of workplaces, or a political group. The actual behaviour of actors is, however, not conceived as determined by their representative tasks or recorded according to rational, goal-seeking patterns. Rather, «we can look at an actor network as being engaged in creating an identity space, which can be described in the very mixed vocabulary of values, myths, political strategies, styles, and taste – in moral-political as well as in aesthetic categories» (:192).

The theoretical base that Gärtner & Wagner draw upon views systems development as 'cultural practices' and 'socio-technical dramas'. The authors themselves point to the fact that an interpretation in terms of 'particularly shaped identities' may conceal the political nature of practices. They state that «Actor networks are networks of powers and dependencies, ...» (:193), and refer to «the power of established networks» (:211). Power is, however, also related to *places*: «...it is important to look at the specific location or place from where these powers act. These places can be a local or national union, the offices of a company's top management, a specific workplace, a consultant firm, . . . Each of these places hosts its own political framework which in turn shapes what its inhabitants hold as a legitimate standard, value, interest, or procedure.» (:193).

When research in cadastral issues aspires to extend from the Continental European homeland of the cadastre it is surely mandatory that different cultural practises are recognized and accounted for. However, for cadastral research the investigation of cultural practices is a means rather than an end in its own right. It is, therefore, questionable how cultural aspects ought to be addressed.

This issue is illustrated by another study that does not address cultural aspects. The study used a similar set of terms to describe how the German law of chemical substances came into being (Schneider, 1988), however with a different interpretation. Volker Schneider conceived *actors* as holders of power relative to other actors of a *policy issue network* and *arenas* as the places where actors meet, e.g. OECD working groups, Parliament, boards of organizations, and secret working groups. Arenas in terms of commissions and working groups changed during the process. The legitimate *agendas* of the arenas were understood as largely determined by the actors who set up the arenas (working groups with their terms of reference). The pace and direction of development was determined by the actors and their bargaining with their power resources of different forms: technical knowledge, position in governmental hierarchy, organizational strength, reputation relative to social dynamics, among others. The reconstruction of the chain of events and the assessment of power resources, etc. were objectivized as far as possible.

The benefit of the approach of Schneider is

that a decade of events, spanning several countries and interest groups, is elicited into a tight, consistent record. Furthermore, the law development process, or drama if you prefer, is treated with the same search for rigor that one would find in the natural sciences. Schneider's concept set and research design can thus be related to the positivist paradigm, surely a benefit in the context of the challenge of cadastral studies that were mentioned at the end of previous section.

A limitation is, however, that such research design presupposes a practice of setting up commissions, etc. in pursue of quasi rational solutions of the actor's rather explicitly established goals. Such practice demands a specific culture, namely a high level of bureaucratic maturity of the country concerned, a national appreciation of rational approaches, and furthermore a country so big that the national expertise in a specific field is generally objectivized and not the monopoly of a single person. This culture cannot be expected globally, and it is thus a research issue to develop a research design which benefits from both the cultural practice/ interpretivist approach and a rather positivist approach. What can be concluded from this section is, however, that the concept set of actors, actor networks, arenas, and agendas must be included in the theoretical basis of cadastral research.

## 6. The cultural setting of the cadastre, and its implications for research

The previous section indicated that an understanding of the development of national information systems need to include cultural issues. One can narrow the question of how this is done best, by taking into consideration that information systems, and especially national information systems, need a certain culture, in terms of practices and values, to operate. More specifically, the cadastre presupposes a specific culture, not only by the surveyors and civil servants involved, but also by the society at large. This issue is illustrated by a quotation of the article by Gärtner and Wagner, and some implications for cadastral research are stated.

The recording of real estates and the protecting of real property rights must be rooted in the government and the procedures of a constitutional state (*Rechtsstaat*). The idea of 'govern by rule and not by man', and its development into

modern bureaucracies or public administrations, is a means to secure a high level of predictability and stability. The compliance with and enforcement of rules is the precondition for the general trustworthiness of agreements on all levels: individual, collective, and national.

However, one may question the norm of loyalty towards rules. One type of critique of the norm is moral, as it sees a too strict compliance with governmental rules as a denial or suppression of individual responsibility (cf. Germany 1933-45). Another type is rather economic, as it sees the formalization and inflexibility of bureaucracy as an impediment to efficiency. Critique may, however, also be raised as a means to undermine the strength of the bureaucracy when it discloses and attacks vested interests. The issue of loyalty towards norms is vast.

The mixed values that are related to bureaucracies are illustrated very well by the following quotation: «.. the existence of numerous conventions and local procedures .. create the strange situation in which human actors and technical objects evolve predictably, as if acted on by rules to which they confirm» (Gärtner & Wagner, 1996:194). The text goes on by seeking ways to achieve a «more dynamic and flexible [network]».

A bureaucracy may indeed be as strange, difficult to accomplish, and culture specific as an Indonesian dance, and much research is needed to assess to what extent it is advisable and possible to transfer such culture specific practice to other regions of the globe. For the present it is assumed that a certain – and rather high – level of predictability in the social sphere is a necessity for operating and developing a cadastre. Consequently, the means to achieve such predictability: rules, procedures, and humans who act according to rules, etc. must be part of cadastral investigations.

A draft design for cadastral research can be motivated as follows: The information content and maintenance of existing cadastre and related information systems are described by a positivist approach, using system analysis tools. This accounts for the predictable aspect of the cadastre and includes the prescripts that specify the information flows and databases. In parallel, a preliminary investigation is made of the actors and arenas (in Schneider's sense) that are concerned with cadastral information, including the end users. An investigation of the cultural practices (Gärtner & Wagner, 1996: 193f)

should enable an informed choice of the research design of the main investigation. A key issue is whether a sufficient number of actors demonstrate an intention of integrative, co-ordinated action or not.

Options for a subsequent investigation are mentioned below. The two first-mentioned are within the positivist approach, the third within the interpretivist approach. Options include:

- to identify and overcome concrete, observed obstacles, for example by reducing the dissimilarity of the actors' conceptual models of the information system (cf. Wierda, 1991: 173)
- to chart the events within an actor network as a quasi rational, bargaining process, conducted by actors with rather explicitly stated and integrative objectives, cf. Schneider's approach.
- to interpret the events within an actor network as a playing with words without real commitment. Changing purposes may motivate the proposed new system and the designated responsible person finds reasons to transfer the idea to others. «The collective games actors play build upon complicity, shared experiences, and complementary interests rather than on integration» (Gärtner & Wagner, 1996: 193).
- to engage in discussion on basic concepts and norms as real property, government, justice, and scientific method, recognizing that also science is culturally bound, or – in other words – to question the proposed view of the cadastral problem domain (Fig 4).

A similar ordering is quoted by (Wierda, 1991: 10) noting that different development strategies are needed for development of inter-organizational information systems, dependent on the decision-making structure within the network. After further review of the research literature he conducts a case study in the positivist tradition.

In (Stubkjær, 1996) mention is made of different 'levels' of investigation. The first and second regard measurement and mapping of terrain objects and the performance of routine property transactions, respectively. The main objects of the third level are the organisations (actors) who issue and maintain the prescripts of level one and two. The activities of the third level are conceived as «a trade with resources of a societal nature». The outcome of this trade is

new or revised prescripts of any kind, e.g. laws, by-laws, or technical standards regarding the cadastral information flow, and new or changed organisational units. A fourth level was identified as the level of philosophy, and of scientific and moral norms. Methodological issues were only implicitly addressed, but for each level reference was made to specific theory elements.

The above account of different research approaches to cadastral studies may be seen as a development of the ideas of the previous work.

## 7. Conclusion

The cadastral problem domain has been charted on the basis of an early Danish work and two internationally oriented textbooks. The textbooks presented a logic of development for the cadastre that has been related to research in information systems development (ISD). The survey of ISD research focused on research paradigms and noted the fact that alternatives to the established natural science (positivist) approach became recognised in ISD research after the 1980s. Cadastral research can, by following that pattern, keep the rigor of the related geodetic research as appropriate and still be able to address the social and cultural aspects that are inherent in the cadastral domain. Danish experiences with information systems development have earlier been reported with reference to actor network theory (Stubkjær, 1992). A similar approach was identified within recent ISD research. This and the above survey led to proposals for the design of future cadastral research.

## References

- Betænkning (1972)* Betænkning om landinspektøruddannelsen (Report on the (Danish) land surveying study programme). Den Danske Landinspektørforening. København. 69 p.
- Dale, Peter F. & John D. McLaughlin (1989)* Land Information Management – An introduction with special reference to cadastral problems in Third World countries. Clarendon Press. Oxford. 266 p. 1988, reprinted.
- Eason, Ken (1988)* Information Technology and Organizational Change. Taylor & Francis. London. 247 p.
- Eichhorn, G (1981)* Das FIG-Symposium in Darmstadt – Eine Zusammenfassung. Papers, FIG XVI. Internat. Kongress, Montreux, Schweiz, Vol 3, paper 304.1.

- Gärtner, Johannes & Wagner, Ina (1996) Mapping actors and Agendas – Political Frameworks of System Design and Participation *Human-Computer Interaction* Vol 11, no 3, pp 187–214.
- Hirschheim, Rudy, Klein, Heinz K. & Lyytinen, Kalle (1995) Information systems development and data modeling – Conceptual and philosophical foundations. Cambridge University Press. 289 p.
- Hirschheim, Rudy, Klein, Heinz K. & Lyytinen, Kalle (1996) Exploring the intellectual structures of information systems development – A social action theoretic analysis *Accounting, Management and Information Technologies* Vol 6, no 1/2, pp 1–64
- Johnston, R.J. (1999) Geography and GIS. Pp 39–47 in Longley, et al (Eds) *Geographical Information Systems*. 2nd edition, Vol 1.
- Klein, Heinz K. (1999) Knowledge and methods in research – From beginnings to the future. Keynote paper IFIP WG 8.2 Conference, St.Louis, August 20-22, 1999 (In press)
- Kling, Rob (1994) Introduction to the Special Issue on Social Science Perspectives on IS *acm Transactions on Information Systems* Vol 12, nr 2. 117 ff.
- Kling, Rob (1999) What is Social Informatics and Why Does it Matter? *D-Lib Magazine* January 1999, Volume 5 Number 1, ISSN 1082-9873. <http://www.dlib.org/dlib/january99/kling/01kling.html>
- Larsson, Gerhard (1996) Land registration and cadastral systems – Tools for land information and management. Longman, Essex, UK. 175 p. 1991, reprinted.
- Longley, Paul A. , David J. Maguire, Michael F. Goodchild & David W. Rhind (Eds) (1999) *Geographical Information Systems*. 2nd edition, Vol 1-2. John Wiley. New York.
- Moyer, D. David & Fischer, Kenneth Paul (Eds) (1976) Land parcel identifiers for information systems. American Bar Foundation. Chicago Press.
- Mørup, E. (1880, 1893) Samling af collegiale og ministerielle Circulairer og Skrivelser m.m. vedrørende Landinspektørernes virksomhed (Compendium of circular letters and administrative rulings of relevance for the activities of land surveyors). Del I 1782 – 1879; Del II 1880 -1892. Den Danske Landinspektørforening. København.
- Pickles, J (1999) Arguments, debates, and dialogues – The GIS-social theory debate and the concern for alternatives. Pp 49-60 in Longley, et al (Eds) *Geographical Information Systems*. 2nd edition, Vol 1. John Wiley. New York.
- Schneider, Volker (1988) Politiknetzwerke der Chemikalienkontrolle – Eine Analyse einer transnationalen Politikentwicklung. Berlin, Gruyter.
- Sheppard, E. (Ed) (1995) Special issue: GIS and society. *Cartography and GIS* 22 (1).
- Stubkjær, Erik (1992) The development of national, multi-purpose spatial information systems – Danish experiences in a theoretical context. *Computers, Environment and Urban Systems* Vol 16, no 3 (May/June 1992) p 209-217.
- Stubkjær, Erik (1994) Employing the Linguistic Paradigm for Spatial Information. In: *Advances in GIS research: Spatial Data Handling Conference*, Sept. 1994, Edinburgh / Waugh, Thomas C; Healey, Richard G (Eds). Edinburgh, University of Edinburgh. Vol 1, pp 572-587.
- Stubkjær, Erik (1996) A Theoretical Basis for Cadastral Development. *Proceedings, Third Seminar of the European Co-operation Network for Education and Research in Land Information Systems (EUROLIS)*, Sept. 1994. Delft; Delft University of Technology, 1996. – pp 0.9 – 0.23.
- Wierda, Folkert W (1991) Developing interorganizational information systems. Dr. Thesis TU Delft. ISBN 90-9004069-2. Delft. 213 p.